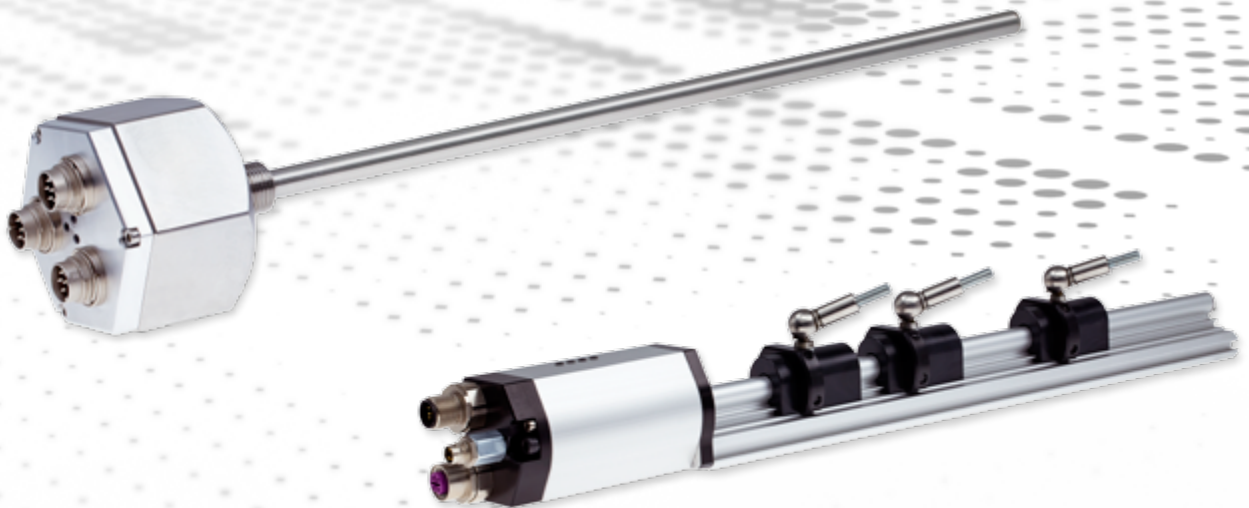
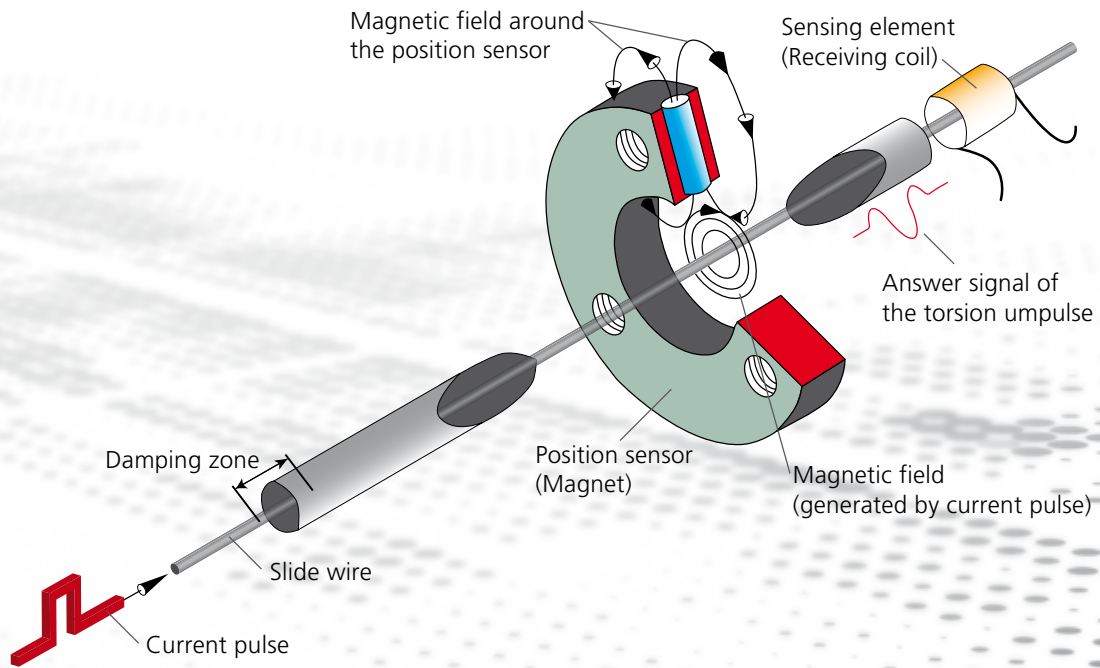


Linear Encoders

Overview



Magnetostriction



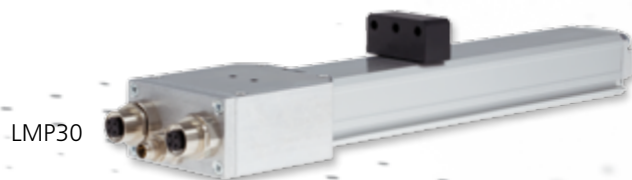
Functional Description

The magnetostrictive linear encoders of TR capture linear movements and convert them into electrical output signals. This measuring principle is based on a travel time delay measurement.

Current pulses are sent through a magnetostrictive wire, positioned inside a protective tube, creating a ring-shaped magnetic field around the wire. A non-contact permanent magnet serves as a position sensor, touching the waveguide with its magnetic field. The magnetic field created by the current pulses generates a magnetostriction at the point of

measurement due to the two differently aligned magnetic fields. The resulting torsion pulse spreads out from the position sensor with constant ultrasonic speed, moving along the waveguide in both directions.

The time difference between the transmission of the torsion pulse and its arrival at the sensing element at the detector head is converted electronically into a distance proportional signal, which is provided either as a digital or analog output signal.



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Linear Encoder - Magnetostriction - Tube Housing



The universal standard for absolute position detection.

Linear absolute encoders for touchless measurement (based on magnetostriction) sense linear absolute movements without wear or tear, even in aggressive media. Pressure proof protection tubes made from stainless steel allow direct integration into hydraulic cylinders. For easy exchange of sensing element, choose the version „H“ with detached protective tube - the tube remains in the cylinder, the system keeps pressurized. Depending on the interface, multiple detection is possible. Depending on mechanic execution, the measure-

ment systems are fully integrated into hydraulic cylinders or are accessible from the outside. Linear encoders are available with a big number of interfaces beginning with direct analogue output up to high speed industrial ethernet. A special device is the triple redundant LMR70 - three independent measurement systems in one tube guarantee longterm availability for applications with difficult access.

LA46

LMR48

LMR70

| Product | LA46 | LMR48 | LMR70 |
|--------------------------------|--|--|---|
| |  |  |  |
| Mechanic Execution | (R) Tube, (H) detachable Tube | (R) Tube | (R) Tube |
| Range | 50...4000 mm*, in steps | 50...3000 mm*, in steps | 50...2000 mm |
| Size | 46 | 48 | 70 (triple redundant) |
| Supply Voltage | 24 VDC, -20...+10 %* | 12...24 VDC, +- 10% | 24 VDC, -20...+20 % |
| Resolution | 0,005 mm | 0,05 mm | 12 bit or 16 bit |
| Linearity defect | ± 0,10 mm ≤ 1500 mm ± 0,15 mm > 1500 mm | ± 0,04 % + 1 LSB | ± 0,10 mm ≤ 1500 mm ± 0,15 mm > 1500 mm |
| Reproducibility | 0,005 mm | | 0,04mm |
| Hysteresis | 0,02 mm ≤ 1500 mm 0,1 mm > 1500 mm | 0,1 mm | 0,02 mm ≤ 1500 mm 0,1 mm > 1500 mm |
| Temperature coefficient | < 15 ppm/°C > 500 mm * | ± 30 ppm/°C | < 15 ppm/°C > 500 mm * |
| Ambient temperature | -20...+70 °C; 0...+70 °C | -40...+85 °C | -40...+85 °C |
| Protection Class | IP65 | IP65, Option IP69K | IP65 |
| Options | Multimagnet*, tube tip support | SIL 2, PLd | tube tip support |
| Orientation | any desired | any desired | any desired |
| Material | Cr/Ni-Alloy | Cr/Ni-Alloy | Cr/Ni-Alloy |
| maximum pressure | 600 bar, static | 450 bar, static | 600 bar, static |
| Interface | <p>SSI </p> <p>Analog </p> <p> </p> <p>CANopen </p> <p> </p> | <p>SSI CANopen</p> <p>Analog</p> | Analog |
| Weblink | www.tr-electronic.com/s/S006913 | www.tr-electronic.com/s/S007102 | www.tr-electronic.com/s/S008380 |
| QR-Code |  |  |  |

* depends on interface

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Linear Encoder - Magnetostriction - Profile Housing



The universal standard for absolute position detection.

Linear absolute encoders for touchless measurement (based on magnetostriction) sense linear absolute movements without wear or tear. Depending on the interface, multiple detection is possible. Families LP46 and LMP48 are suitable for magnet sliders and can guide the magnet. Family LMP30 is flat, magnets are to be guided by customer side mechanics. Linear encoders are available with a big number of interfaces beginning with direct analogue output up to high speed industrial Ethernet.

LP46

LMP30

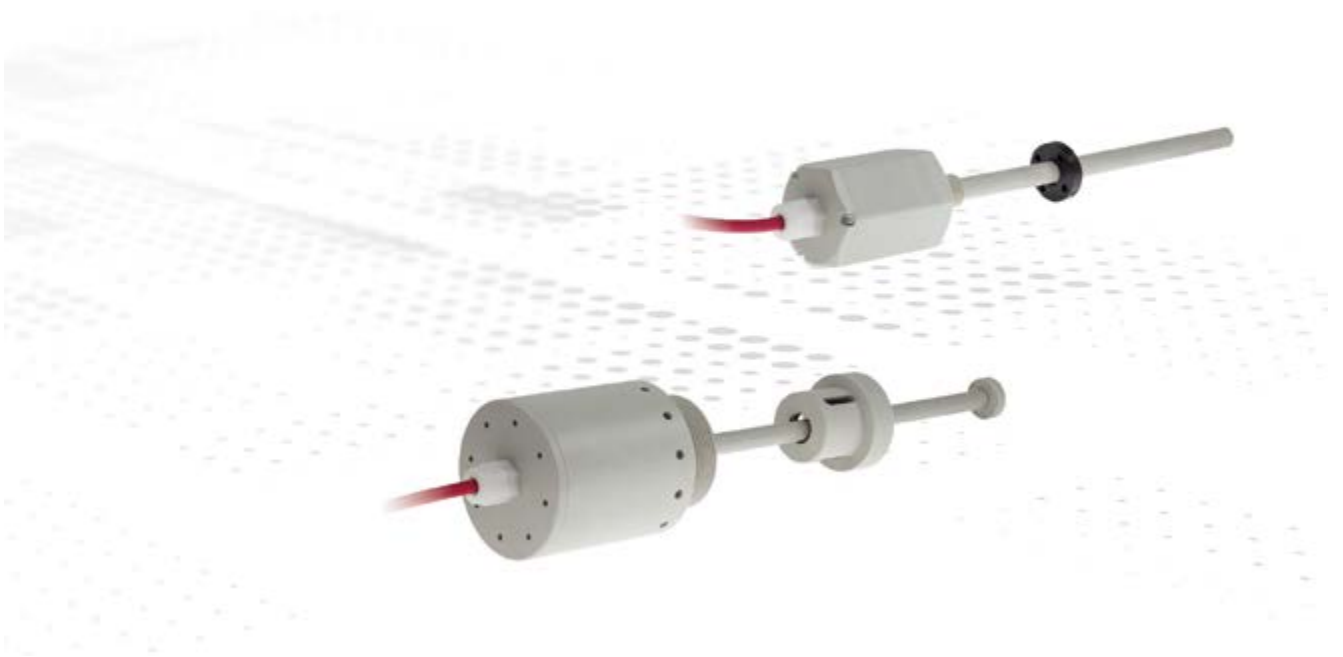
LMP48

| Product | LA46 | LMP30 | LMP48 |
|--------------------------------|---|---|---|
| |  |  |  |
| Mechanic Execution | (P) Profile | (P) Profile | (P) Profile |
| Range | 50...4000 mm*, in steps | 50...4000 mm*, in steps | 30...3000 mm*, in steps |
| Size | 46 | 30 | 48 |
| Supply Voltage | 24 VDC, -20...+10 %* | 24 VDC, -20...+10 %* | 24 VDC +- 20%; 9...36 VDC * |
| Resolution | 0,005 mm | 0,01mm * | 0,05 mm |
| Linearity defect | ± 0,10 mm ≤ 1500 mm ± 0,15 mm > 1500 mm | ± 0,15 mm ≤ 1500 mm ± 0,20 mm > 1500 mm | < 0,01 % FS, ≥ 60 µm ± 0,1 % FS * |
| Reproducibility | 0,005 mm | 0,005 mm * | < 0,005 % FS ≥ 50 µm ± 0,1 % FS * |
| Hystheresis | 0,02 mm ≤ 1500 mm 0,1 mm > 1500 mm | 0,02 mm ≤ 1500 mm 0,1 mm > 1500 mm | ± 0,1 % FS * |
| Temperature coefficient | < 15 ppm/°C > 500 mm * | < 8 µm/°C ≤ 500 mm < 15 ppm/°C > 500 mm * | 100 ppm/°C |
| Ambient temperature | -20...+70 °C; 0...+70 °C | -20...+70 °C; 0...+70 °C | -40...+75 °C; -20...+75°C |
| Protection Class | IP65 | IP65 | IP67 |
| Options | Multimagnet*, Atex Zone 2/22, | Multimagnet* | SIL 2, PLd* |
| Orientation | any desired | any desired | any desired |
| Material | Aluminum extruded profile | Aluminum extruded profile | Aluminum extruded profile |
| maximum pressure | | | |
| Interface | <p>SSI </p> <p>Analog </p> <p> </p> <p>CANopen </p> <p> SERCOS the automation bus</p> | <p>SSI </p> <p>Analog </p> <p>ISI </p> <p> </p> <p>CANopen</p> | <p>SSI CANopen</p> <p>Analog</p> |
| Weblink | www.tr-electronic.com/s/S008394 | www.tr-electronic.com/s/S008395 | www.tr-electronic.com/s/S008396 |
| QR-Code |  |  |  |

* depends on interface

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Linear encoder with plastic housing







For aggressive surroundings

Linear absolute encoders for touchless measurement (based on magnetostriction) sense linear absolute movements without wear or tear. For explicit aggressive surroundings, TR provides the series LA 50 and 80 in plastic housing. The full measurement system is housed in Polypropylene (PP) or, on request, in Polytetrafluorethylene (PTFE). These materials withstand most liquids in industrial applications. Series LA 50 is optimized for liquid level measurement. It is mounted with a tube thread acc. DIN 259 (Size R2) into process vessels. The

swimmer can not be lost due to a mechanical block at the end of the tube. The Series LA 50 can be used similar to the standard range LA46. With different magnets available, it can be used for precise position measurement in aggressive surroundings.

LA50

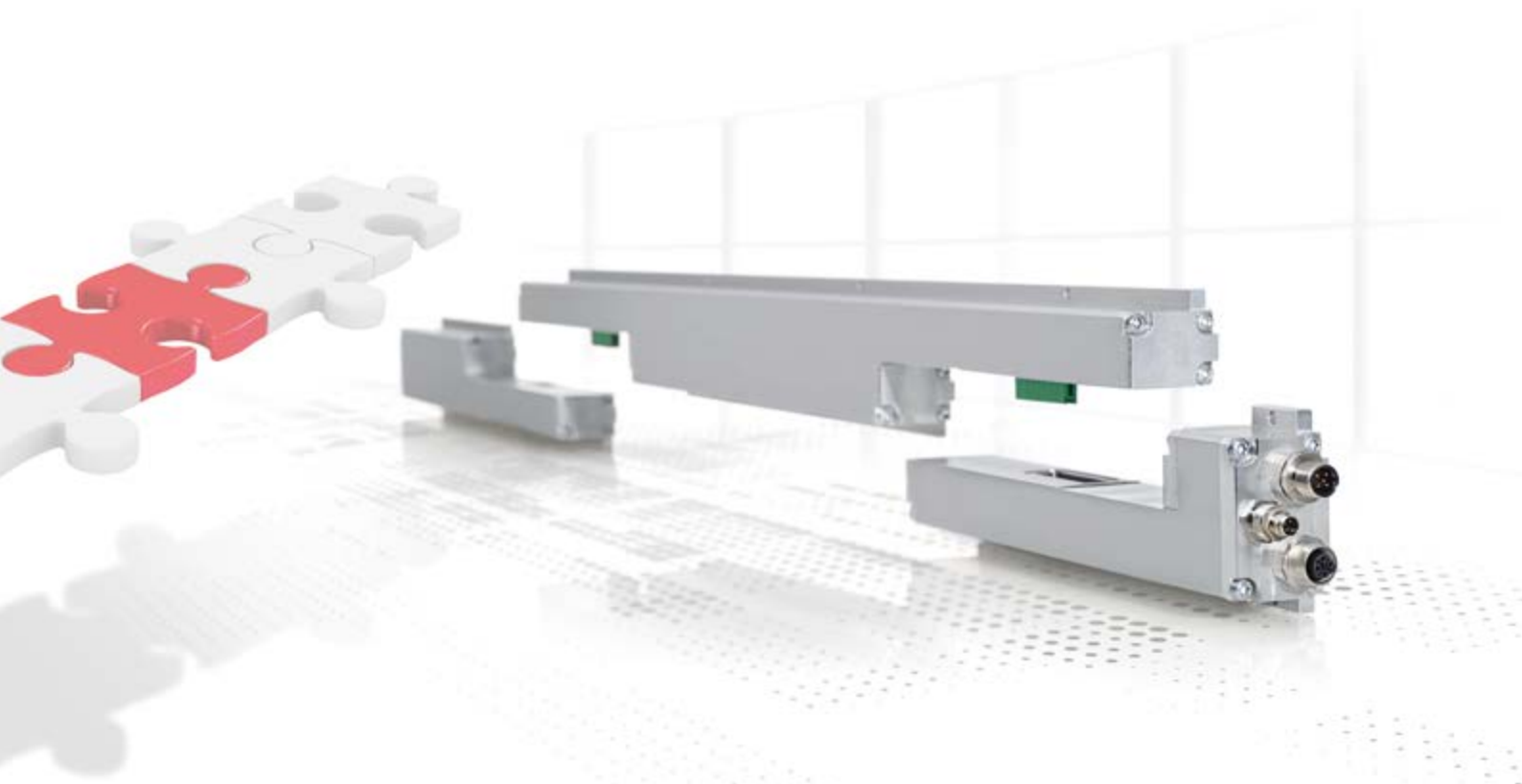
LA80

| Product | LA50 | LA80 |
|--------------------------------|--|--|
| |  |  |
| Mechanic Execution | (R) Tube (plastic) | (R) Tube (plastic) |
| Range | 100 ... 10000 mm (in steps) | 100 ... 10000 mm (in steps) |
| Size | 50 | 80 |
| Supply Voltage | 24 VDC, -20...+10 % | 24 VDC, -20...+10 % |
| Resolution | 0,001 mm | 0,01 mm |
| Linearity defect | ± 0,10 mm | < 0,05 % |
| Reproducibility | 0,005 mm | 0,01 mm |
| Hysteresis | 0,02 mm | 0,1 mm |
| Temperature coefficient | < 8 µm/°C * | < 8 µm/°C * |
| Ambient temperature | -20...+70 °C; 0...+70 °C | -20...+70 °C; 0...+70 °C |
| Protection Class | IP68 | IP67 |
| Options | | |
| Orientation | any desired | any desired (when used as level sensor: vertical) |
| Material | PP (Option PTFE) | PP (Option PTFE) |
| Interface | SSI | SSI |
| Weblink | www.tr-electronic.com/s/S008501 | www.tr-electronic.com/s/S008502 |
| QR-Code |  |  |

*depends on Measurement Length and Interface

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Cascadable Linear Encoders








Measure reliably over long distances

Wire-actuated encoders are subject to wear, laser measuring systems cannot acquire several positions simultaneously in the same clear width. Magnetic tapes are susceptible to ferromagnetic chips, position marks read optically with readers can become soiled, magnetostrictive measuring systems are limited in their measuring length, glass scales are unaffordable from certain measurement lengths.

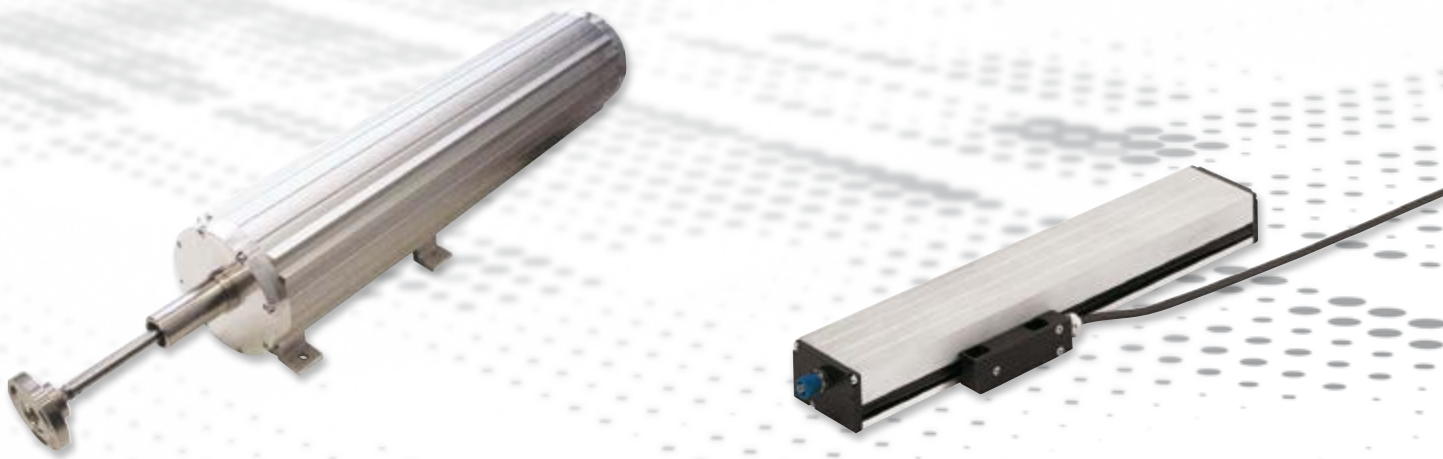
The final measuring length is defined in-situ by connecting the intermediate elements together to the desired overall length. Up to 20 m absolute position detection is supplied as standard (special lengths on request).

- _ Wear-free measurement up to 20 m
- _ Compact, convenient pieces made from strand-cast aluminium
- _ Closed housing, flat surface
- _ Flush (no beads or edges)
- _ Easy installation possible without special tool
- _ Interfaces: PROFIBUS, CANopen, EtherCAT
- _ Magnets do not require any supply leads

Cascadable, ≤ 20 m length

| | |
|--------------------------------|---|
| Product | LMC55  |
| Supply voltage | 24 VDC, -20 ... +10 % |
| Current consumption no load | 24 ... 30 VDC |
| _ Master system | < 60 mA |
| _ Single component | < 90 mA |
| Measuring principle | magnetostrictive |
| Measuring length, standard | 5 ... 20 m |
| Resolution | 0,05 mm |
| Linearity deviation | < 0,02 %, $\pm 0,20$ mm/Module |
| Reproducibility | 0,05 mm |
| Hysteresis | 0,1 mm |
| Material - Measuring body | Aluminium extruded profile |
| Cycle time, internal | ≤ 2 ms |
| Optional Magnets | 30 |
| Magnet - Minimum distance | 100 mm |
| Working temperature | 0 ... +70 °C |
| Working temperature optional | -20 ... +70 °C |
| Storage temperature, dry | -30 ... +85 °C |
| Protection class | IP65 |
| Stray magnetic field | < 3 mT |
| Measuring reference | Measuring plane |
| Interface others on request |    |
| Weblink | www.tr-electronic.com/s/S008458 |
| QR-Code |  |

Glass scale / transformation



High-resolution absolute position sensors with glass scale

The TR measurement systems of the LT product family work on the principle of photoelectric scanning of an absolute coded glass scale. A sensor array scans several tracks that contain high resolution measurement information on the 3D Coordinates and angular position between the glass scale and the scanning unit.

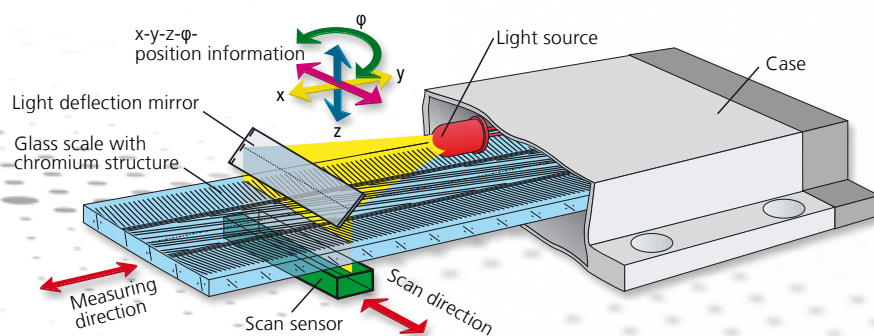
Evaluating the measurement signals, the coded measurement position is determined by the sensor signal and due to the additional measurement information, guidance and adjustment errors are completely corrected.

With a smallest measurement step of 0.1 μm our transformation measurement systems are especially suitable for applica-

tions with high demands on resolution and accuracy.

Due to their robust construction, they find their application even in Machines with strong vibrations. With absolute detection, no more referencing is necessary – even when using only the incremental interface, controls can take benefit from the virtual referencing:

On request, the measurement system sends a number of incremental signals that represent the absolute position value read by the sensor. The counter in the control is loaded with the absolute position information without any mechanical movement of the axis. As detection is absolute, the only

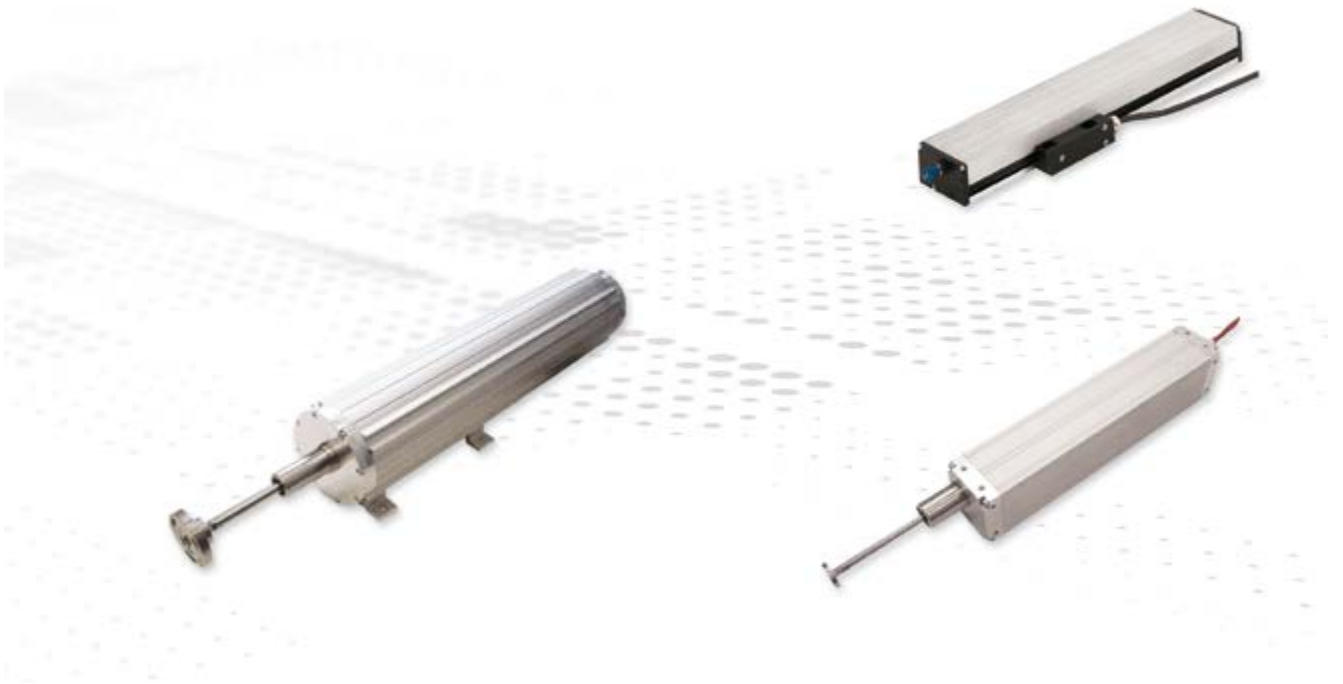


limitation in travel speed is given by mechanics with approx. 10 m/s. The measurement system always provides valid measurement values.

Our measurement systems of the LT series are available in following versions:

- _ With measuring slide, also with several sensing heads within the same system, e.g. for the positioning of several cutting blades in paper cutters.
- _ With mechanically non-interacting measuring axis, suitable for application in running production.
- _ With special protective housing for heavy duty applications, e.g. directly on rolling production lines.

Linear Encoders - Transformation (Glass Scale)



The rugged, absolute glass scale for precise measurement directly in your manufacturing line

High-resolution glass scales made by TR-Electronic work even in harsh conditions of a manufacturing facility. Due to the internal absolute detection, a current absolute reading value is available shortly after power up and without any mechanical referencing. With the feature "virtual referencing", even systems that use only the incremental track can take full benefit of absolute measurement. Different executions fit different applications.

LT-S: Measurement system with sliders, that can hold multiple

sliders on one glass track. This system is mechanically compatible to incremental scales of other manufacturers. With optional inlets for protective air, this measurement system can be used in dusty surroundings.

LT-PI: The rugged version for normal production applications. Either as probe sensing system or with a spring-loaded probe. This is the system for accurate measurement in your machine.

LT-RV: In extreme conditions, the protective housing of LT-RV keeps the electronics safe even with strong vibration and shock.

Slider Touch Probe Heavy Duty Touch Probe

| Product | LT-S | LT-PI | LT-RV |
|--|--|--|--|
| |  |  |  |
| Mechanic Execution | Slider | encapsulated touch rod probe measurement system | Heavy Duty touch rod probe measurement system |
| Range | 140 ... 3040 mm (steps of 100 mm) | 100, 200 mm | 400, 520 mm (up to 800 mm on request) |
| Reproducibility | < 0,2µm | < 0,2µm | < 0,2µm |
| Supply Voltage | 24 V dc (8...30) | 24 V dc (8...30) | 24 V dc (8...30) |
| Resolution | 0,1µm, 0,2µm, 0,5µm, 1µm, 2µm, 5µm, 10µm | 0,1µm, 0,2µm, 0,5µm, 1µm, 2µm, 5µm, 10µm | 0,1µm, 0,2µm, 0,5µm, 1µm, 2µm, 5µm, 10µm |
| Division incremental signal | 0,4µm, 1µm, 2µm, 4µm, 10µm, 20µm, 40 µm | 0,4µm, 1µm, 2µm, 4µm, 10µm, 20µm, 40 µm | 0,4µm, 1µm, 2µm, 4µm, 10µm, 20µm, 40 µm |
| Signal level Incremental | TTL, HTL | TTL, HTL | TTL, HTL |
| Division Sin/Cos | 10µm, 20µm, 40µm | 10µm, 20µm, 40µm | 10µm, 20µm, 40µm |
| Arbeitstemperatur | 0°C...65°C (Option -20°C...65°C) | -10 ... +60°C | 0 °C...40 °C (Option -10...+60°C) |
| Schutzart | IP 53 | IP 66 | IP65 |
| Optionen | Multiple Sliders, protective Air | Spring loaded sensing probe | |
| Verfahrgeschwindigkeit | 10 m/s | 10 m/s | 10 m/s |
| Einbaulage | any desired | any desired | any desired |
| Interface | SSI | SSI | SSI |
| Option, additional interfaces (on request) | INC | INC | INC |
| Weblink | www.tr-electronic.de/f/TR-VLT-TI-GB-0200 | www.tr-electronic.de/f/TR-VLT-TI-GB-0300 | www.tr-electronic.de/f/TR-VLT-TI-GB-0400 |
| QR-Code |  |  |  |

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Laser distance measuring systems



Measurement over long distances without contact & fast enough for closed-loop control

Laser distance measuring systems from TR-Electronic are powerful optical sensors, which enable measurement of long distances without contact. The measuring system comprises a laser light source, light collector, electronic evaluation and data interface.

Our laser distance measuring systems enable absolute and wear-free measurement of long distances up to 240 m, which can then be output via SSI, field bus interface or Industrial Ethernet. Our barcode positioning systems even enables an absolute measuring distance of 10,000 meters. In addition: On our in-house laser reference measuring

section we can compare our laser measuring systems of up to 240 m with a reference system and also linearize them accordingly. We can thus achieve an absolute repeatability of ± 1 mm at speeds which are commonplace in high rack warehouses.



Laser distance measuring systems – LE200























Measurement over long distances without contact and fast enough for closed-loop control

Particularly in the area of modern warehouse setups, such as shelf-stacking devices, transfer belts and crane systems, a powerful, decentralized measuring and control system for simple project processing and quick configuration makes all the difference. Movements up to 240 m are recorded with the LE-200 laser distance measuring device. The visible red light laser facilitates commissioning and adjustment of the measuring system. A continuous light beam is used during operation. With just 1 millisecond of measuring cycle time, the LE-200 can be directly used for position control.

- _ robust design
- _ recording linear movement patterns
- _ contact-free and wear-free distance measurement
- _ Distances up to 125 m, 170 m, 195 m, 240 m
other distances on request
- _ Flexible programming
- _ others interfaces on request
- _ option with Integrated heating
- _ Customized adaptations upon request

Position detection up to 240 m

| Product | LE200 | LE200 – long range |
|--------------------------------------|---|---|
| |  |  |
| Supply voltage | 18 ... 27 VDC | 18 ... 27 VDC |
| _ Integrated heating | 24 ... 30 VDC | 24 ... 30 VDC |
| Current consumption no load | < 350 mA | < 350 mA |
| _ Integrated heating | < 2,5 A | < 2,5 A |
| Measuring range | 0,2 – 125 m | 0,2 – 170 m, 195 m, 240 m |
| Linearity deviation (12 m, standard) | ±3 mm | ±3 mm |
| Reproducibility | ±2 mm | ±2 mm |
| Light source | Laser diode, Red light | Laser diode, Red light |
| Wave length λ | 670 nm | 670 nm |
| Radiant power | $P_{\max} \leq 1$ mW | $P_{\max} \leq 1$ mW |
| Laser protection class | 2 | 2 |
| Measurand output/refresh rate | 1.000 Values / s | 1.000 Values / s |
| Integration time | 1 ms | 1 ms |
| Working temperature | 0 ... +50 °C | 0 ... +50 °C |
| Working temperature (+ heating) | -30 ... +50 °C | -30 ... +50 °C |
| Storage temperature | -20 ... +75 °C (dry) | -20 ... +75 °C (dry) |
| Protection class | IP65 | IP65 |
| Vibration | ≤ 50 m/s ² , sine 50 ... 2,000 Hz | ≤ 50 m/s ² , sine 50 ... 2.000 Hz |
| Shock | ≤ 300 m/s ² , Half sine 11 ms Hz | ≤ 300 m/s ² , Half sine 11 ms Hz |
| Interface others on request |         |         |
| Weblink | www.tr-electronic.com/s/S007232 | www.tr-electronic.com/s/S007232 |
| QR-Code |  |  |

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Laser distance measuring systems – LLB65 / LLB500








Non-contact measurement on natural surfaces

Laser distance measuring systems LLB65 and LLB500 can measure up to 65 m on natural surfaces without a special target plate. The measuring time and the maximum speed of the target depend on the surface. LLB 500 can measure up to 500 m with a target plate.






- _ Analog and PROFIBUS-DP interface
- _ RS232 -, RS422 - - interface
- _ Detection of positions
- _ Non contact distance measurement
- _ Distance measurements on natural surfaces:
 - _ 0,05 m up to approx. 65 m
 - _ LLB500 mit reflector panel up to 500 m
- _ Programmable
- _ Option with Integrated heating

Position detection of quasi static targets up to 65 m

| Product | LLB65 (H) - A | LLB65 - PB |
|--------------------------------------|--|--|
| |  |  |
| Supply voltage | 9 ... 30 VDC | 13 ... 30 VDC |
| _ Integrated heating | 24 ... 30 VDC | – |
| Current consumption no load | ≤ 0,6 A | ≤ 0,6 A |
| _ Integrated heating | ≤ 2,5 A | – |
| Measuring range | typically 0,05 m ... 65 m | typically 0,05 m ... 65 m |
| Linearity deviation (12 m, standard) | 0,1 mm | 0,1 mm |
| Reproducibility | ±1,5 mm ... ±3 mm bei 2 σ | ±1,5 mm ... ±3 mm bei 2 σ |
| Time for a measurement | typically 0,3 ... 4 s | typically 0,3 ... 4 s |
| Light source | Laser diode, Red light | Laser diode, Red light |
| Wave length λ | 620 ... 690 nm | 620 ... 690 nm |
| Radiant power | 0,95 mW | 0,95 mW |
| Laser protection class | 2 | 2 |
| Beam divergence | 0,16 × 0,6 mrad | 0,16 × 0,6 mrad |
| Mass | 690 g, 720 g (with heating) | 950 g |
| Working temperature | -10 ... +50 °C | -10 ... +50 °C |
| Working temperature (+ heating) | -40 ... +50 °C | – |
| Storage temperature | -40 ... +70 °C (dry) | -40 ... +70 °C (dry) |
| Protection class | IP65 | IP65 |
| Vibration | ≤50m/s ² , sine 50 ... 2,000 Hz | ≤50m/s ² , sine 50 ... 2,000 Hz |
| Shock | ≤300m/s ² , Half sine 11 ms Hz | ≤300m/s ² , Half sine 11 ms Hz |
| Interface others on request | Analog |  |
| Weblink | www.tr-electronic.com/f/LLB65-A-1-GB-1 | www.tr-electronic.com/f/LLB65-PB-1-GB-1 |
| QR-Code |  |  |

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Position detection of quasi static targets up to 500 m

| Product | LLB500 (H)-A | LLB500-PB |
|--------------------------------------|--|--|
| |  |  |
| Supply voltage | 9 ... 30 VDC | 13 ... 30 VDC |
| _ Integrated heating | 24 ... 30 VDC | – |
| Current consumption no load | ≤ 0,6 A | ≤ 0,6 A |
| _ Integrated heating | ≤ 2,5 A | – |
| Measuring range | typically 0,05 m ... 500 m | typically 0,05 m ... 500 m |
| Linearity deviation (12 m, standard) | 0,1 mm | 0,1 mm |
| Reproducibility | ±1,5 mm ... ±3 mm bei 2 σ | ±1 mm ... ±3 mm bei 2 σ |
| Time for a measurement | typically 0,3 ... 4 s | typically 0,3 ... 4 s |
| Light source | Laser diode, Red light | Laser diode, Red light |
| Wave length λ | 620 ... 690 nm | 620 ... 690 nm |
| Radiant power | 0,95 mW | 0,95 mW |
| Laser protection class | 2 | 2 |
| Beam divergence | 0,16 × 0,6 mrad | 0,16 × 0,6 mrad |
| Mass | 690 g, 720 g (with heating) | 950 g |
| Working temperature | -10 ... +50 °C | -10 ... +50 °C |
| Working temperature (+ heating) | -40 ... +50 °C | – |
| Storage temperature | -40 ... +70 °C (dry) | -40 ... +70 °C (dry) |
| Protection class | IP65 | IP65 |
| Vibration | ≤50 m/s², sine 50... 2.000 Hz | ≤50m/s², sine 50... 2.000 Hz |
| Shock | ≤300 m/s², Half sine 11 ms Hz | ≤300m/s², Half sine 11 ms Hz |
| Interface others on request | Analog SSI |  |
| Weblink | www.tr-electronic.com/f/LLB500-A-1-GB-1 | www.tr-electronic.com/f/LLB500-PB-1-GB-1 |
| QR-Code |  |  |

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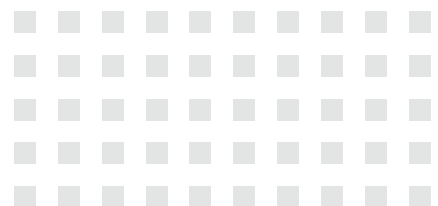
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Subject to technology and design modifications.

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